

Seismic Weigh-in-Motion

Vehicle and roadway measurements can be made with seismic sensors

We are exploring the use of seismic sensor arrays to perform various transportation-related measurements. Primarily, we have demonstrated the feasibility of a noninvasive, inexpensive measurement of a vehicle's weight without having to stop it on a mechanical scale. An array of seismometers records ground displacement data from a moving vehicle, and that data are used to determine the signal characteristics generated by the vehicle. Signal processing algorithms are then employed to estimate vehicle weight.

Field testing of the technology

In conjunction with the California Department of Transportation, we conducted field experiments with a truck moving by a 40-foot-long array of seismometers located on the shoulder of a roadway. The digitized data were recorded for subsequent computer processing. The recorded signal can be represented as the sum of high- and low-frequency terms. The low-frequency component is associated with pavement distortion and the high-frequency with vehicle suspension assembly characteristics. We found that there is a positive correlation between the measured signal amplitude from the sensors and the vehicle weight.

APPLICATIONS

- Screening loads of moving trucks
- Identifying vehicles
- Detecting subsurface road damage

An advance in weigh-in-motion methods

Advantages of the proposed system are its nonintrusiveness and use of hardware that is both inexpensive and portable. An important feature of our seismic system is the measurement of ground disturbances

surrounding the path of the vehicle, the area generally perturbed by the moving source. This can help to overcome technical difficulties of attempting to estimate the static weight of an object in the presence of complex dynamic forces of the wheels and axles of a moving vehicle interacting with uneven pavement.



A truck passes by a seismic sensor array, which will determine vehicle weight from ground disturbances.

Determining vehicle speed and highway damage

Because the amplitude of the sensor signals is dependent on speed, this array can also be deployed for traffic control to determine vehicle speed. A similar system could be used to study the highway degradation problem. In transportation research there is significant interest in the deterioration of the pavement, bridge, and highway foundations. The signals recorded from the array have propagated from the source to the receiver through the ground, and can therefore be used to noninvasively detect damage via signal distortions.

Availability: Equipment for data gathering exists, but collaboration is required to produce a prototype system.

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